INDOOR AIR QUALITY ASSESSMENT

Harvard Elementary School
Old Wing
27 Massachusetts Avenue
Harvard, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of Michael Sireci of the Massachusetts Teachers Association (MTA), the Bureau of Environmental Health Assessment (BEHA) was asked to provide assistance and consultation regarding indoor air quality issues and health concerns at the old wing of the Harvard Elementary School, 27 Massachusetts Avenue, Harvard, Massachusetts.

` On September 4, 2002, a visit was made to this school by Michael Feeney, Director of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to conduct an indoor air quality assessment. Mr. Feeney was accompanied by Tom Hamilton of OccuHealth, Inc. (an indoor air quality consulting firm), Mr. Sireci and other Harvard School Department personnel.

The school houses kindergarten through 6th grade students. The original building, erected in the 1970s, is a one-story red brick building that rests on a concrete slab over a crawlspace. The building consists of a main central corridor flanked by classrooms. A two-story red brick addition was added in 1991. The second floor consists of general classrooms. The first floor contains general classrooms, gymnasium, cafeteria, art room, library, teacher's workroom and school offices. BEHA staff conducted a previous assessment of the building and a report was issued detailing conditions observed at that time (MDPH, 1999).

Methods

Visual observation of the crawl space, the interior of unit ventilators (univents) and gypsum wallboard (GW) was conducted during normal school operations.

Results and Discussion

Old Wing

As noted in the previous report, a musty odor was detected in the main corridor of the old building. In the original report, BEHA staff attributed this odor to carpet in the main hallway (MDPH, 1999). The musty odor was detectable upon entering the old wing from the newer section of the building during this assessment. The crawlspace consists of a combination of cement foundation wall and a dirt floor (see Picture 1). The crawlspace had a musty odor, indicating that water penetration mixing with dirt may be creating microbial growth. The source of moisture penetrating the interior of the crawlspace appears to be runoff of rainwater from the roof system. The wing is covered with a double-peaked roof (see Picture 2). It does not appear that the roof is outfitted with rain gutters or downspouts (see Pictures 3 and 4). As a result, rainwater runs off the roof onto the ground at the base of the building. Over the years, this runoff has created a trench parallel to the base of the wall along the grass on the north side of the building. This trench allows rainwater and melting snow to pool against the foundation and the exterior wall. Rainwater from the south section of the roof of the building empties directly onto a tarmac apron at the base of the exterior wall (see Picture 5). It appears that it was intended to direct rainwater to storm drains. While the majority of the tarmac apron slopes to the storm drains, the apron beneath the roof edge appears to be sloped *towards* the foundation (see Picture 6), allowing rainwater to come into contact with the exterior wall/tarmac junction. A number of cracks and several potholes (see Pictures 7 and 8) have developed in the driveway, which will also allow water to accumulate and

pool along the south wall of the building. Exacerbating this are a number of plants growing in the junction between the exterior wall and the tarmac (see Picture 9). Water can gather in the wall/tarmac seam where these plants were observed. Freezing and thawing of gathered water can result in damage to the exterior wall. Over time, this process can undermine the integrity of the building envelope and provide a means of water entry into the building through capillary action via foundation concrete and masonry (Lstiburek & Brennan, 2001). This condition may also allow for water to pass through the foundation walls to moisten the dirt of the crawlspace.

Several pathways exist for crawlspace air to migrate into occupied areas of this wing. The interiors of univents in the wing were spot-checked. Walls in which univents are installed have spaces and holes within the air handling cabinet (see Pictures 10 and 11). In addition holes exist in the floor for the univent heating pipes (see Picture 12). Spaces exist around heating pipes that can allow for air to be drawn from the crawlspace and be dispersed into classrooms by univent fans. Please note that holes also exist in the rear wall of univents that open into the exterior wall system. These holes can serve as pathways to draw air from the exterior wall cavities. The existence of these holes allows for air to by-pass univent filters, resulting in the aerosolization of materials (e.g. dust) into classrooms.

In an effort to determine if other sources of odors exist in the univents, the exterior louvered wall grate was removed. A significant amount of moistened outdoor debris was found between the exterior louvered wall grate and bird screen (see Picture 13). This material can serve as a mold growth medium, producing odors and mold spores.

A grated hole was noted in the floor of the hallway (see Picture 14). The grate was removed, revealing that it opened directly into the crawlspace. It is possible that the hole serves as an exhaust vent for the hallway. Assuming the hole was designed as part of the hallway exhaust system, this configuration has a number of drawbacks that would limit it usefulness:

1. If the hallway ventilation system is deactivated off hours, this hole now serves as a migration path for crawlspace air into occupied space. With the ventilation system deactivated, heated air from uninsulated HVAC system pipes and the boiler room can create drafts that rise from the crawlspace into the hallway. This column of moving air can then draw mold, spores and associated odors from the crawlspace, which then can accumulate in the hallway overnight.
2. This configuration draws air into the crawlspace as an uncontrolled pathway. The ungrated hole can serve as a means for fire to spread from the hallway into the crawlspace.
3. The exhaust vent for the duct appears to be heavily coated with debris that has fallen through the hole. This type of accumulation may result in the deterioration of the duct.

The renovation that added the new wing appears to have abandoned hallway radiators (see Picture 15). Heating pipes were cut from the radiators. Similar pipes were noted in the crawlspace. Since neither end of these pipes appeared sealed, each of them may serve as pathways for crawlspace air to penetrate into the hallway.

Room 111/113

During the course of this assessment, a teacher had indicated that a problem existed in an interior wall of classroom 111. An examination of this wall revealed microbial growth in gypsum wallboard (GW), behind a shelf. A number of boxes stored on this shelf (see Picture 16) and the carpet (see Picture 17) appeared to be colonized with microbial growth. On the opposite side of the mold colonized wall is a custodial closet (see Picture 18). Several linear feet of GW within the custodial closet also had corresponding mold colonization. The source of moisture appears to be plastic hoses connected to a cleaning solution dispenser (see Picture 19 and 19A). The purpose of the dispenser is to provide an appropriate mix of tap water and cleaning solution, which is then dispensed into a mop bucket for use via the plastic hoses. After filling, an amount of cleaner/water solution remains in the plastic hose. Since soap is a surfactant that can reduce the capillary action of water, the addition of cleaner will allow for water to more readily run out of the tube. For this reason, the tube used to deliver the cleaner/water solution should be placed inside the sink to drain the residue. Dispenser hoses were found touching the floor beside the sink, which would allow for the cleaner/water solution to empty onto the floor and moisten GW. The most obvious mold growth on GW was observed in close proximity to mop buckets and the cleaning solution dispenser's hoses.

In order to become colonized by mold, a material must be exposed to water and remain moist. Porous materials such as cardboard, GW and carpet can all support mold growth if sufficiently moistened (US EPA, 2001). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried

with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a fungicide to moldy carpeting is not recommended.

Conclusions/Recommendations

The conditions observed in the old wing are somewhat complicated. In order to address the conditions listed in this assessment, the recommendations to improve indoor air quality in this building are divided into short and long-term corrective measures. The **short-term** recommendations can be implemented as soon as possible. **Long-term** measures are more complex and will require planning and resources to adequately address the overall indoor air quality concerns within this school wing.

In order to prevent musty odors in the old wing, a strategy of mitigation, elimination of pathways, source elimination and improvements to rainwater drainage need to be implemented. Based on the findings at the time of the visit, the following recommendations are made:

Short-Term Recommendations

Old Wing

1. Continue to implement the recommendations made in the previous BEHA report.
2. Remove accumulated debris inside univent fresh air intake grilles.
3. Clean accumulated particulates from the air handling and control cabinets of each univent.

4. Seal all holes in the walls of the univent air handling cabinets to limit filter bypass. Double sided, foil faced insulation with adhesive applied in a manner to create an airtight seal can be installed.
5. Seal wall and pipe floor holes within univent casing.
6. Seal walls in the rear of each univent cabinet to prevent air draw from the exterior wall cavity.
7. Remove all vegetation from the exterior wall/tarmac seam. Seal the exterior wall/tarmac junction with a water impermeable sealant.
8. Identify the purpose of the hallway floor vent. If its purpose is to serve as an exhaust vent, consider connecting the hole to the exhaust system using a flexible duct of sufficient diameter in order not to inhibit function.
9. Seal abandoned piped originally connected to hallway radiators.

Room 111/113

1. Remove mold contaminated GW in a manner consistent with recommendations found in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001. Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html
2. Remove and discard mold contaminated carpet and shelves from room 111.

Long-Term Recommendations

1. Install gutters and downspouts along the eaves of all sloped roofs. Install downspouts in a manner to direct rainwater at least five feet from the north exterior wall to prevent pooling along the foundation.
2. Examine the feasibility of re-paving the tarmac apron on the south exterior wall to slope away from the edge of the building toward the storm drain. Once done, apply an appropriate sealant to the seam between the tarmac and building exterior wall.
3. Consult a building engineer concerning the most appropriate method to provide active mechanical exhaust ventilation to place the crawlspace under negative pressure. Placing the crawlspace under negative pressure will reverse air penetration into occupied spaces. Please note that crawlspace exhaust vents should not expel crawlspace air near univent fresh air intakes.
4. Please note that installation of crawlspace mechanical exhaust ventilation must not draw air from the boiler room. If this occurs, products of combustion may be drawn from the furnace into the crawlspace. The construction of a wall to separate the boiler room from the furnace may be necessary.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

Lstiburek, J. & Brennan, T. 2001. Read This Before You Design, Build or Renovate. Building Science Corporation, Westford, MA. U.S. Department of Housing and Urban Development, Region I, Boston, MA

MDPH. 1999. Indoor Air Quality Assessment, Harvard Elementary School, Harvard, Massachusetts. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA. February 1999.

US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, D.C. EPA 402-K-01-001. March 2001.

Picture 1

Dirt Floor Of Crawlspace

Picture 2

Double-Peaked Roof Over Old Wing

Picture 3

South Roof Edge, Note Lack Of Gutter/Downspout

Picture 4

North Roof Edge, Note Lack Of Gutter/Downspout

Picture 5

Tarmac Driveway Along South Exterior Wall Of Old Wing

Picture 6

Tarmac Sloped Towards South Exterior Wall Of Old Wing

Picture 7

Pothole In Tarmac Along South Exterior Wall Of Old Wing

Picture 8

Cracks In Tarmac Along South Exterior Wall Of Old Wing

Picture 9

Plants Growing From Tarmac/Exterior Wall Seam

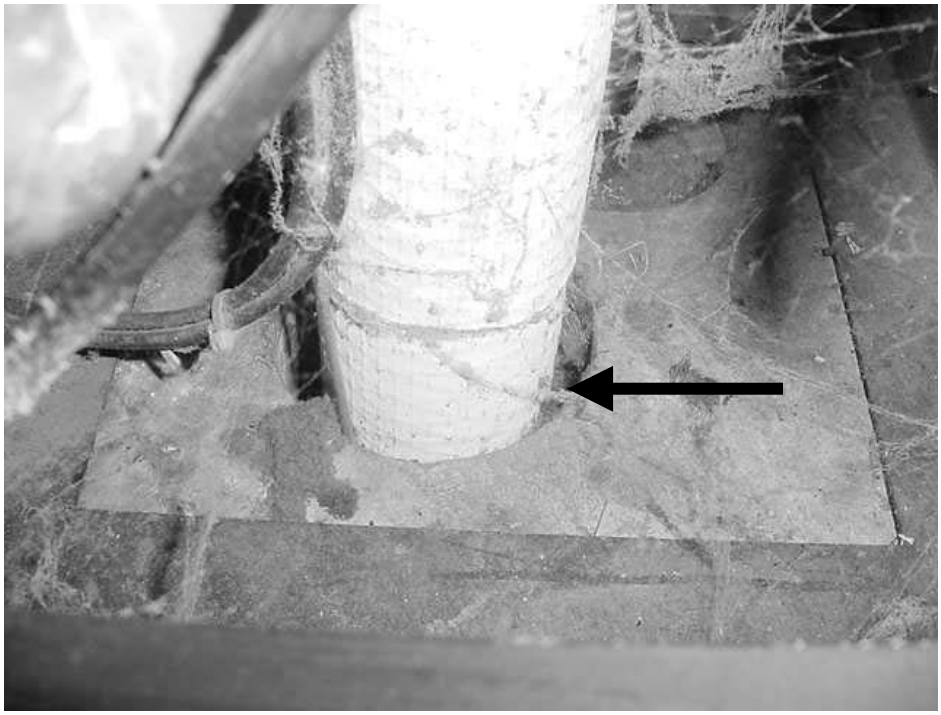
Picture 10

Hole In Air Cabinet Wall

Picture 11

Hole In Air Cabinet Wall

Picture 12



Space Around Pipe Inside Univent Cabinet

Picture 13

Debris Inside Fresh Air Intake Louver

Picture 14

Grate In Floor Of Hallway

Picture 15

Abandoned Hallway Radiators

Picture 16

Mold Colonized Boxes, Room 111

Picture 17

Mold Colonized Wooden Shelves And Carpet, Room 111

Picture 18

Mold Colonized Gypsum Wallboard In Custodial Closet

Picture 19

Cleaner Dispenser, Note Hoses

Picture 19A

Cleaner Dispenser Hose, Note Moistened Floor And Hoses